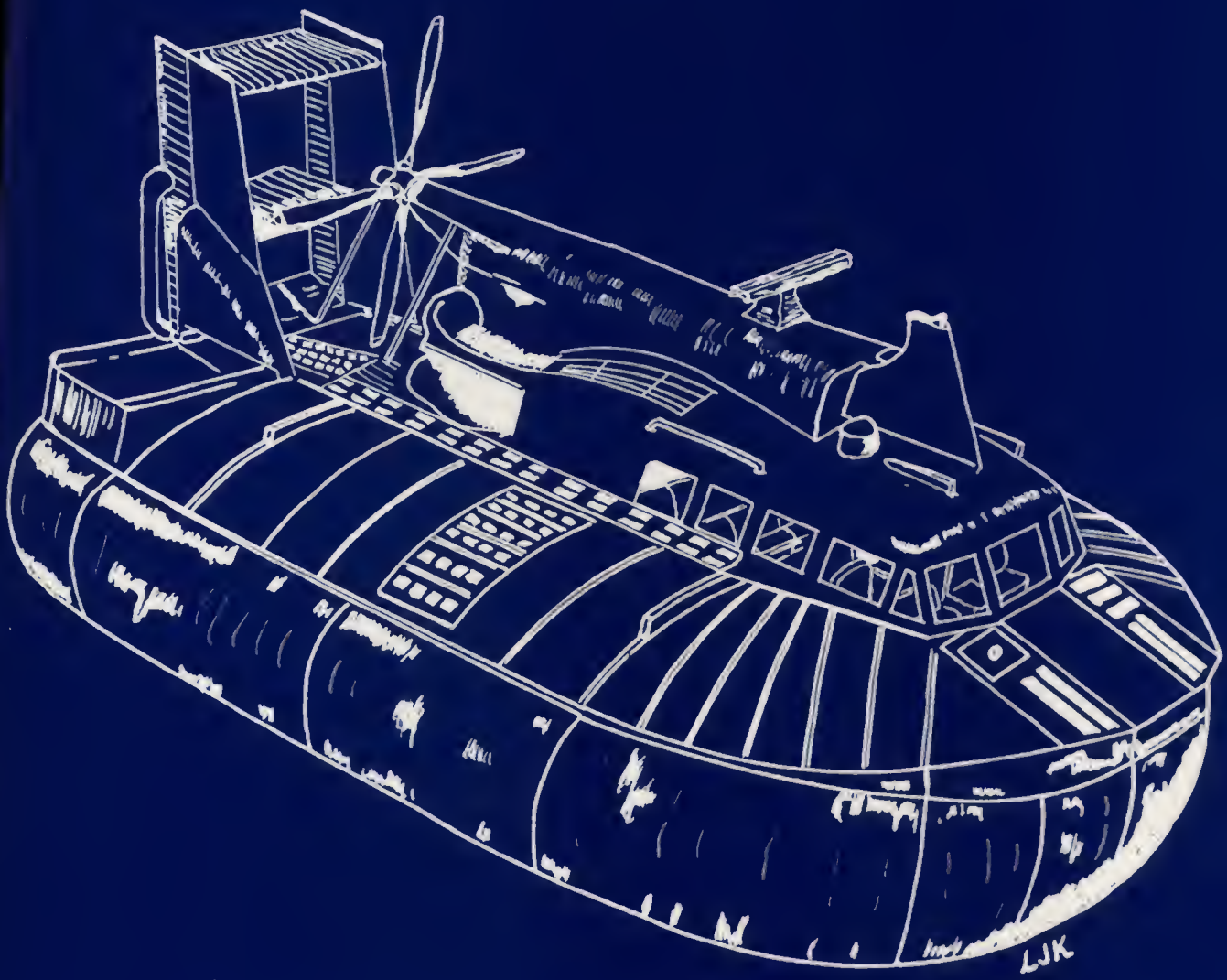
Mecheleciv

Volume 25 March - 1967 No. 4



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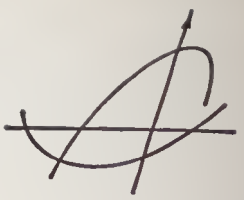

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MECHELECIV

CULTURE AND THE ENGINEER

During their pursuit of an education at The George Washington University, engineering students experience the stigma of the uncultured. While there are some individual exceptions, the great majority of engineers encounter a less than cordial attitude from other members of the university community. It is only natural that engineers isolate themselves from liberal influences when they encounter resistance to broadening attempts.

A definition of culture is necessary before the terminology can be applied to specified groups of people. Matthew Arnold has defined culture as "knowledge of the best that has been thought and said in the world." Thomas Henry Huxley, a contemporary of Matthew Arnold, has defined the essence of culture as a criticism of life. Therefore, it seems quite credible that culture is properly defined without reference to science or the arts. It should also be clear that culture can be obtained equally well through the scientific or classical approaches. Ideally though, a most comprehensive criticism of life would be obtained through familiarity with both disciplines.

Now that the concept of culture is defined, it follows logically that classical and scientific approaches should be examined for the purpose of determining their relative merit. It is evident that students may obtain an adequate cultural background through studies of liberal arts. The Great Books contain a wealth of information which provides an adequate base for a cultural education. However, understanding the concepts involved in the classical literature is often impeded by a lack of familiarity with the scientific approach to education. Students who adhere to the classical approach without the aid of scientific knowledge encounter considerable difficulty in obtaining their goal.

The same problems exist for persons who would achieve cultural competence by the scientific process. Although the rudimentary ideas are present, as in the classical literature, gleaning them from the superfluous can be achieved only with considerable effort. Criticism of life is found in scientific works in a very subtle context and can be easily overlooked. For this reason, we have scientifically competent students who are not fully aware of the cultural advantage to be gained from their books. Scientists and engineers can eliminate the stigma by obtaining an insight into the classical thoughts and writings. In addition, students versed in liberal thinking will gain greater insight from their reading of scientific works.

A strong argument exists for obtaining a thorough understanding of both the scientific and classical approaches to cultural competence. However, many students will persist, for one reason or another, in following only one of the dual approaches. Progress of this type usually results in misunderstanding of the cultural worth of its counterpart, and thus creates a significant problem. The only solution is for proponents of classical culture, as well as proponents of the scientific method to recognize that the alternative exists. After recognizing this, all students would find themselves stimulated to broaden their cultural attainment, thus decreasing friction between the factions involved.

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ARTICLES

DEPARTMENTS

COVER:
A ground effect machine now being used in Vietnam.

FRONTISPIECE:
An open forum in which alumni are questioned by students on engineering opportunities and careers.

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Uncle Sam, too. For a machine with no mind of its own, the mighty teleprinter can immediately verify the computer programmed signal sent to a space craft. And give a visual analysis before the signal has a chance to be executed — an instant check for accuracy. It will be used, for instance, at far flung tracking stations as a precautionary check factor during the Apollo moon mission.

Dumb-Dumb machine? Maybe. Or maybe just lonesome. But once it gets together with a system . . . look out!

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MOTOROLA

LETTERS TO THE EDITOR:

During the recent open forum on the Hollomon Report there were many comments made and questions raised about details. These details concerned the transfer of credits and debits within the University, efficiency (whatever that means) of the S.E.A.S. operation, registration for the first two years in the Columbian College, etc. It is possible to discuss these points ad infinitum, but without ever approaching the real problem and meeting it face to face.

Because I think that no one at the forum adequately discussed the significance of the Hollomon Report, I have written the analysis and I make the suggestions that follow.

As I see it, the final report of the Hollomon Committee (and I think also the purpose of that committee) was not the elucidation of details of immediate S.E.A.S. operation. It was not to tell us what minor adjustments we could make to "break even" financially and academically, but instead it was to provide an analysis of what to do if we are really interested in becoming a significant engineering school.

There is no doubt the George Washington University is in a unique position, being in close proximity to government agencies, research foundations, planning centers, and "think" industries. Washington is a center of national organization and planning in many fields that have a need for engineering personnel and research facilities. That the Engineering School has been unable (or has not seriously attempted) to take advantage of this situation is the great problem (I think I should say tragedy) that we now face.

No matter how much we "tighten our belts" and make the S.E.A.S. an efficient operation, no matter how much we change the curriculum to make it easier and more attractive for undergraduates to change to engineering, the Engineering School will be in approximately the same position that it is now, ten years from now. We just cannot get our sailboat to sail by standing on the deck and holding a fan to the sail. We need to create a wind in our environment.

What we need is to attract interest in the form of research contracts and monetary aid from the government foundations and the industries that surround and in fact are Washington. This is precisely how M.I.T. and Caltech have become the renowned schools that they are. They grew right along with and presently coexist with industries that surround them. We can do the same thing. The only question is how to accomplish it.

And this is where we fall flat on our faces: Before we can attract money and brains, we must be known for something. We must have a name, a reputation. But in order to get such a name, we must attract money and brains!

This enigma can only be solved by somehow getting enough financial power to attract a select expert to the Engineering School. This expert must be an engineer renowned for his accomplishments in a field indigenous to Washington. The fields listed in the Hollomon Report (i.e. biomedical engineering, city planning, air pollution...) would be "naturals". We must become truly exceptional in one of these fields by actively supporting our chosen expert in whatever research programs he can undertake in cooperation with the government or industry in Washington. For instance, if we had a foremost expert in air pollution on our staff, it would be possible to attract a great deal of research money from the government, which is currently very interested in this field. This would make possible the wider offering of graduate fellowships and would attract a more dynamic and permanent graduate enrollment. If this program could be supported continuously and vigorously, the result would be a steadily growing and significantly useful engineering school that would excell in all areas, graduate and undergraduate.

This plan requires precipitous action. It means we must take a chance. It means we must take one bounding leap upward, for a series of small horizontal steps can never overcome the forces pushing us down into mediocrity.

But how does one take this leap? Who is to do it? I propose that Dean Mason appoint a small, efficient committee, or perhaps just one person, to decide which field (such as city planning, air pollution, etc.) we shall choose to "become eminent in" and then set about by every means available to raise the money (hopefully with help from the university) to get on our staff a permanent, full-time expert in that field, the prime requirement being that he have a big name and exceptional organizational and even political ability.

Obviously this is an exceedingly difficult thing to do. The problem of getting enough money will most likely be the hardest to surmount, but surmount it we must, because the alternative is to keep making small ineffective changes within the existing structure and scope that will at best only forestall a later decline. The forces about us are moving too rapidly to wait around for a school content to tighten its belt and wait for better days. It is time to actively create those better days or else we shall sink back into the darkness of oblivion.

--Leo A. Danisch

AIR CUSHION VEHICLES

by Lawrence J. Kastner

The Ground Effect Machine (GEM) or Air Cushion Vehicle (ACV) can play a role in two broad and distinctly different areas of transportation. They are:

1) Operation over improved terrain. This is typified by the use of prepared highways, rail systems, etc. The Hovair or tracked ACV concept offers potential application to such operation.
2) Operation over rough and unimproved terrain. Examples of such terrain are water, sand, snow, natural fields with ditches, holes, rocks, and debris and all the various types of natural terrain normally encountered in off-the-road transportation. Ground effect vehicles utilizing the principle of the plenum chamber or the annular jet typify the class of ACV's which offer the potential of operating over such terrain.

The air-cushion train

The principal elements of any transport system are support, guidance and motive power. If we combine air-cushion suspension with linear induction motors and electrical power pickoff, we have the basic concepts of the British tracked Hovercraft (200-250 mph) and the General Motors Hovair (100-400 mph).

These tracked ACV concepts are in an early stage of their development. Important questions as to their feasibility relate to aerodynamic and air-cushion noises, which might require reduced speeds in urban areas; stability of the air cushion at high forward speeds; stability of the vehicle against side wind gusts; weather independence of the system; track alignment after long-term settlement of the guideway; visual discomfort to passengers from high speeds; power-pickoff problems at high speeds; and exclusion of obstacles at high speeds.

The tracked ACV as conceived by the British Hovercraft Development Ltd. uses a concrete track or guideway, has an air-cushion suspension (a height of 1/2" or 1" is envisioned) and lateral guidance system, and a liner induction motor for propulsion.

A six-foot operating model of a tracked ACV was demonstrated on a closed-loop track at the Hovershow at Browndown, England in June 1966. It demonstrated, for the first time, the combination of suspension and guidance by peripheral jet air-cushion with a linear induction motor for propulsion.

Linear induction motors

A linear induction motor is an excellent way to provide traction without contacting the guideway. The linear motor is not subject to the speed limitations of rotary machines; there are no centrifugal forces tending to pull the motor apart. Furthermore, the linear motor can have power-to-weight ratios of 2 or 2-1/2 times that of rotary machines. The motor is partly in the roadbed, partly in the vehicle (see Figure 1). It is noiseless, free of vibration, and does not produce exhaust fumes.

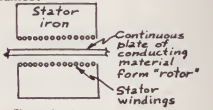


Figure 1. Lineor Induction Motor

In the British version, designed and built by Dr. Eric R. Laithwaite at the Imperial College of Science and Technology, the motor has wound stator poles on the vehicle, with a laid out "rotor" of infinite radius in the guideway. If the motor gap can be kept small, high efficiencies are possible. A linear motor is not grade-limited and a vehicle can maneuver 9% or 10% grades by speed reduction, since traction does not depend on rail adhesion.

Air levitation

Air pressure levitation was studied at the Ford Motor Company in 1960 as a means of support for high-speed ground transportation. However, air levitation has been too costly at the lower speed ranges applicable to regional commuting systems because power is needed even when the vehicle is standing still.

Analysis and experimentation at Ford indicated that pumping power of about 25 hp per ton would be required to levitate a vehicle on a 0.010" to 0.020" air film (called a "levapad" by Ford). Clearly, a disproportionate amount of power would be used for suspension compared with the power needed to overcome rolling resistance of steel wheels on steel rails. At that time, the crossover point came at 300 mph, a speed too high for the short station spacings of rapid transit.

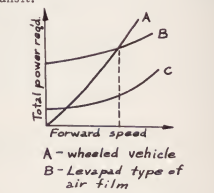
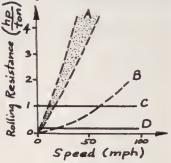


Figure 2

However, the technology of air films has advanced a great deal in the past six years. General Motors has been developing a flexible plenum

air film suspension that changes the picture drastically. The Hovair (see Figure 3) can levitate with pumping power in the range of 0.2 to 1.0 hp per ton on prepared surfaces. The crossover point then comes at about 20 mph on steel surfaces and 60 mph on finished concrete.



A- Pneumatic tires on concrete
B- Railroad wheel on steel rail
C- Hovair on concrete
D- Hovair on steel

Figure 3

Much of the technology discussed so far is appropriate to high-volume transportation serving well defined corridors. Next, let us look at the development and operation of the air-cushion vehicle over unprepared surfaces.

The air-cushion vehicle

As mentioned in the beginning of this article, ground effect vehicles utilizing the principle of the annular jet or the plenum chamber represent the class of air-cushion vehicles suitable for operating over unprepared terrain.

Annular jet and plenum chamber concepts

In simplest terms, the annular jet can be thought of as a nozzle around the perimeter of the ACV, through which a jet of air flows. This is shown in Figure 4.

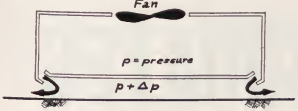


Figure 4. Annular Jet

The plenum chamber concept is similar except that there is no base plate. This difference can best be seen in Figure 5.

ACV development

One can distinguish two phases in the early development of air-cushion vehicles. The nature

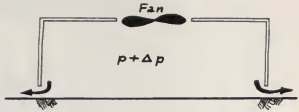


Figure 5. Plenum Chamber

of these two phases can be understood by relating it to attempts to find answers to the following two questions:

1. Will ACV's work?
2. Will ACV's work well, i.e., will they be capable of performing useful missions?

The first phase can be considered to have officially ended on July 25, 1959, following the successful crossing of the English Channel by the Saunders-Roe Ltd. Hovercraft SR-N1 machine. As a result, it is safe to state that the first question has been answered in the affirmative.

The second question is in the process of being answered in Vietnam. The U. S. Command in Saigon revealed December 6, 1966, that three experimental patrol air cushion vehicles participated in a five-day operation against the Vietcong in the Mekong Delta area. These vehicles were produced by Bell Aerosystems Company with technical interchange and license agreement with Westland's Saunders-Roe Division of England.

In view of the tremendous flexibility of operation afforded by the ground effect vehicle over nearly all types of off-the-road terrain, the power requirements as shown in Figure 6 appear to be consistent with the performance advantages. This statement presumes a need for such an off-the-road mobility. There is no question about the military value of such a capability. In fact, there are many commercial applications such as a passenger ferry, utility freight carrier, high-speed search and rescue craft in disaster areas, weed and pest control vehicle, and survey and exploration craft, which could capitalize on such utility.

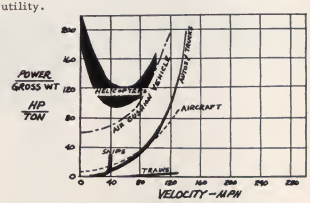


Figure 6. Power Requirements

--Continued on Page 26

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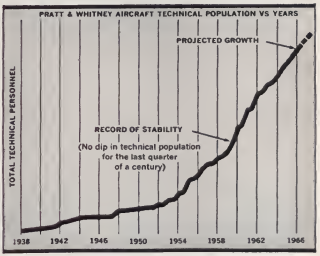

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MECH MISS...

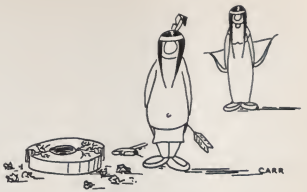
CHRISTY MURPHY

At heart, she is a true Southern girl. Born and raised in Atlanta, Georgia, our newest Mech Miss is Christy Murphy, a 20 year old junior majoring in political science. By considering herself a Southerner, Christy means not so much moonlight and magnolias (though a touch of that suits her well), but more the modern cosmopolitan yet unhurried pace of a native Atlantan. Recently, however Christy has moved to New Mexico, "the Land of Enchantment," and discovered the charm of Indian tradition and Mexican manana. Our Mech Miss is a well-traveled girl and hopes for more such travel in her future.

Presently, Christy is the vice-president of the Student Council, first vice-president of her sorority, Kappa Kappa Gamma, and chairman of the GW Cultural Foundation. She was also a member of the court of the 1967 Engineers' Queen. Christy's interests range from an amateur's enjoyment of golf and skiing to the poetry of W. H. Auden and Gerard Manley Hopkins. And so we present March's Mech Miss - an Irish colleen appropriate for the month of St. Patrick, the patron of engineers.

CHRISTY MURPHY

THE SHAFT



Two male deer were drifting through the forest one evening when they came across a well-furred lady deer.

"Say, what are you doing out this late?" asked one of the male deer.

"Oh, just walking around," replied the lady deer. "What are you two doing?"

"Just out looking for a little doe." answered the two.

"Well," she said slowly, "don't mind if I make a couple of bucks myself."

* * * * *

Peyton Place will be televised to troops in Saigon so they will know that the people back home are suffering too.

* * * * *

A Kappa is defined as one who whispers sweet nothing-doings in your ear.

* * * * *

A harassed father was trying to tell his son that there was to be an addition to the family.

"Son," he said, "Someday soon the stork is going to swoop down over our house." The son thought carefully, then said, "Well, I hope he doesn't scare Mother, she's pregnant, you know."

* * * * *

A man is incomplete till he's married-then he's really finished.

* * * * *

Kappa: "I finally consulted Doctor Jones about this craving I have for Kisses every time I have a few drinks."

M. E.: "Good, what did he give you?"

Kappa: "A few drinks."

* * * * *

A charming gent of the old school had a date with a pretty chorus girl.

They strolled in the Park under the moonlight until they came to a secluded spot where he kissed her several times lightly on the cheek.

"That my dear," he said, "is called spooning."

"Spooning may be all right for you," she said, "but I would rather shovel!"

* * * * *

After a shipwreck, the captain's wife and parrot were drifting about on a raft. Several days of silence had gone by until the parrot finally croaked out, "How's your fanny?"

"Shut up," snapped the woman.

"Mine too," said the parrot. "It must be the salt air."

* * * * *

Marriage is brought about by two people. A single co-ed and her anxious mother.

* * * * *

Pick out the odd one; woman, drum, egg, and sex. (you can't beat sex!)

* * * * *

TECHNICAL JOB INTERVIEWS

Monday March 6	TRACOR Page Communications Gebbs and Cox Naval Ordnance Test Station	Friday March 10	R C A COMSAT
		Monday March 13	Coast and Geodetic Survey Environmental Science Services Administration
Tuesday March 7	Trane Company Allegheny Ludlum Steel Burroughs Corp Hercules Powder	Tuesday March 14	Westinghouse Air Brake Division Hayes, Seay, Mattern & Mattern
Wednesday March 8	Union Carbide/Linde Division Maritime Association Southern Railway	Friday March 17	C I A (On campus on the 16th and 17th of March) T R W
Thursday March 9	Applied Physics Lab	Wednesday March 29	E. I. DuPont

INDEX TO ADVERTISERS

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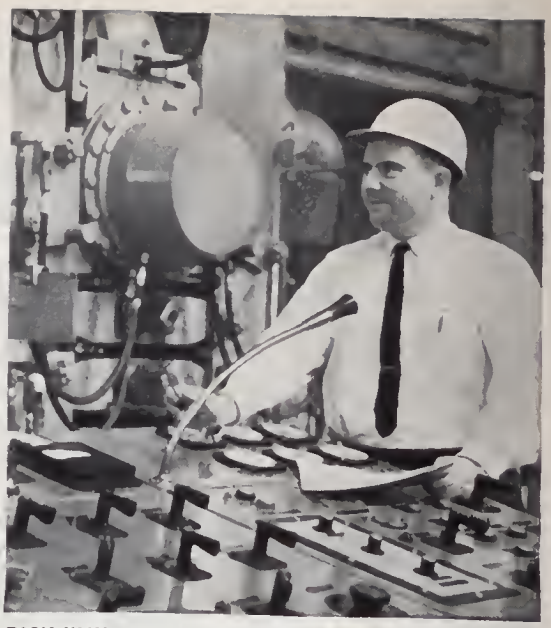

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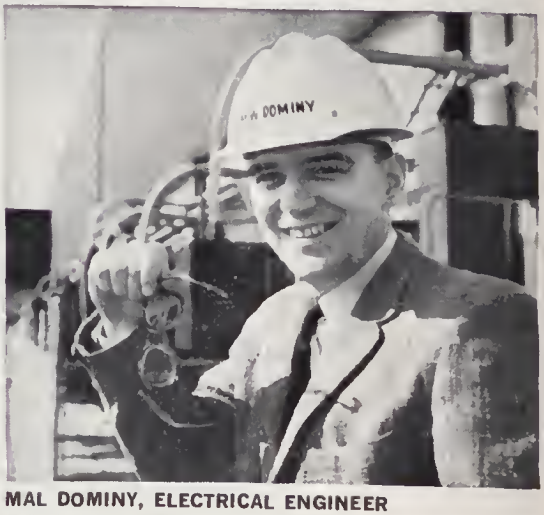

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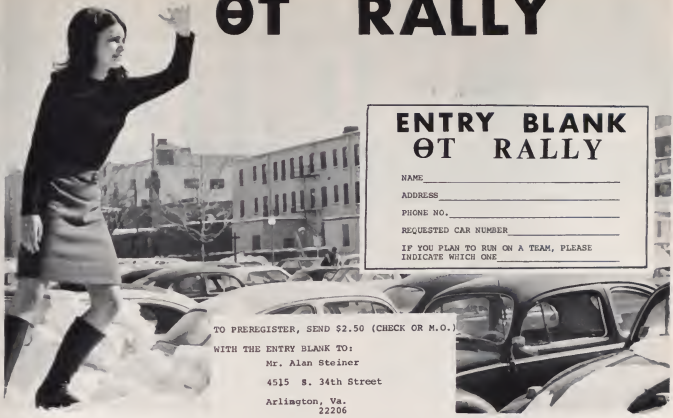

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Mr. Alan Steiner

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Arlington, Va. 22206

by Douglas Taylor

Attention you rally enthusiasts who have been neglected so long by our concrete campus society! Now is your chance to demonstrate your skill behind the wheel and sharpen up the gray cells so long clouded by scientific formulae and engineering know-how. And the best part is that you can have a ball doing all this at Theta Tau's car rally.

Now, before the non-sports car buff turns the page, thinking that this article is directed at the rich and daring who drive those Austin-Martins so plentiful on our student parking lots, let me explain exactly what a rally is.

First you need not drive a sports car or even a compact to compete in this rally. We will be glad to enter you either in your 1927 Pierce-Arrow or your 1967 Lincoln Continental, providing that your father will let you borrow it that weekend.

A rally, contrary to popular belief, is not a test of the ability of your car to withstand pain. Instead it is a test of the combined skill of the navigator and driver to interpret directions and maintain a proper elapsed time between checkpoints. Exceeding the speed limits is not necessary providing you don't get lost and have to make up time.

Now that I can see that you are thoroughly enthused here is the scoop on our upcoming road twister.

Entrance fee is $2.50 if you preregister and $3.00 if you register on the day of the rally. You can preregister by filling out the attached blank and sending it to the indicated address with your registration fee.

Registration on the day of the rally will start at 9:30 a.m. on Sunday, April 12, at the Student Parking Lot #1, with the first car off at 10:30. If you preregister you don't have to show up until 10:15 to pick up your rally number and instructions. Cars will leave at one minute intervals. Hopefully everyone will end up at Carderock State Park for a post rally picnic so pack a lunch. Drinks will be sold at the picnic.

Trophies will be awarded to the top ten percent for both driver and navigator. There will also be special trophies for the best fraternity and sorority team entered in the rally. A team consists of three cars with at least one member of the organization sponsoring the team in each car. Also a special powder puff trophy will be given to the best female driver-navigator combination.

Here is your chance to show your prowess at the wheel and win a handsome trophy for yourself or your organization. Let's see everyone at the Theta Tau rally.

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For two-thirds of a century, Bechtel Corporation has been recognized as a builder for industry and government, and for many years as a leading international engineer-constructor. Under single responsibility, the company provides every service necessary for the complete realization of projects — including economic and technical studies, engineering design, procurement, and construction or project management.

The Bechtel organization is large and diversified, with many staff specialists. Its deep and varied experience, worldwide contacts, and capacity for work are made fully effective for client service by the close integration of all activities under the direct control of the company's management.

COMPANY DESCRIPTION

Bechtel today is the outgrowth of a family construction business established in 1898. During its early years, it played an important role in the development of the West, participating in such projects as Hoover Dam and the San Francisco-Oakland Bay Bridge. Headquarters are in San Francisco, with major offices in various cities of the world.

Activities are geared principally to the requirements of such basic industries as petroleum, petrochemicals, chemicals, natural gas, electric and nuclear power, mining, ore processing and metallurgy, food and paper, cement and other heavy industrial plants — and to land use and development. In the public sector, the firm is active in water use and conservation, rapid transit, and the missile and space program.

Project responsibility is assigned to one of eight operating divisions or to a specialized scientific department. The divisions are Power & Industrial; Hydro & Transportation; Mining & Metals; Refinery & Chemical; Pipeline; International Power, Industrial & Metals; International Petroleum & Chemical, and Vernon, California. The Scientific Development Department provides service to clients directly and also works closely with the company's operating divisions.

Engineering offices are located in San Francisco, Los Angeles, New York City, Washington, D.C., Houston, Montreal, London, Paris, The Hague, and Melbourne.

Bechtel keeps pace with the growing body of scientific knowledge in all its areas of interest. The company will, in the future, continue to meet the requirements of its clients in a rapidly advancing world, with emphasis on work of magnitude, complexity, and challenge.

SPECIAL FEATURES AND ATTRACTIONS

As Bechtel continues to grow, its responsibilities increase, providing capable employees with opportunities for advancement with commensurate financial rewards and personal satisfaction. Bechtel has two separate plans which enable eligible full-time technical and administrative employees to participate in the company's success: the Trust Plan and the Thrift Plan. Contributions to the Trust Plan are made entirely by the company. Participation in the Thrift Plan includes contributions made by employees together with a percentage matching amount by the company on a regular basis.

The Bechtel Group Insurance Plan combines high-limit hospital, surgical, and extended major medical benefits with liberal life insurance coverage for employees and their families.

All the company's major offices are located in areas offering outstanding opportunities for cultural, recreational, and educational activities.

Bechtel is a large and dynamic organization. It is highly competitive in the best sense of the word. An employee's future with the company is up to him. Increased responsibility, accompanied by higher pay, depends upon the combination of appropriate openings and the individual's demonstrated ability to move ahead. Increasing knowledge and effectiveness through participation in professional societies, business study groups, and evening classes can improve one's readiness to assume more responsibility.

OPPORTUNITIES

Assignments in estimating, design and construction are available for engineers in the areas of the company's interest. These include hydroelectric, conventional steam and nuclear power plants; metallurgical processing plants; industrial plants; missile and space development; refineries; petrochemical and chemical plants; pipelines, and developmental research in all these areas. Specialists are employed from many branches of the engineering profession including chemical, mechanical, electrical, civil (structural and hydro), mining and metallurgical, architectural, nuclear, instrumentation, and automatic control engineers.

Engineers may receive, as applicable to their specialties and interests, such responsibilities as:

Estimating

Assist in the preparation of estimates, cost control, and cost analysis of design and construction activities.

Engineering

Assist in development of process design, flow diagrams . . . Prepare piping and instrument diagrams . . . Calculate heat and chemical balance, mass transfer and fluid flow . . . Size equipment . . . Write specifications . . Requisition equipment . . . Design circuits, power distribution systems, lighting and instrumentation . . . Prepare design sketches, drawings or portions of construction plans.

Construction

Plan and schedule field work in close cooperation with project superintendent . . . Inspect equipment as received and after installation . . . Perform quantity take off for equipment, concrete work, structural steel, instruments and piping, electrical conduit and wire. On the basis of this information make preliminary manpower forecasts . . . Read, review and follow job specifications and drawings.

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HIGH SPEED TRAINS

by Louise J. Cherry

For years, railroad passenger service has not kept pace with other mass transportation systems. Because of antiquated service and slow speeds, railroads handle only three percent of all intercity passenger transportation, and railroad company executives would be happy to be relieved of even that small percentage. Despite the dismal picture of railroads, it seems that only they can solve the current transportation problem. The highways are overcrowded now, and Americans will be traveling more, not less, in the future. President Johnson has signed legislation authorizing the Department of Commerce to investigate research and development of high speed ground transportation. Under this program railroad transportation would be speeded up in the Northeast Corridor, the 460 miles between Boston and Washington.

There is an impressive precedent in the example of the new Japanese Tokaido system whose electric express trains now provide the fastest passenger service in the world. Averaging 125 miles per hour on 320 miles of welded track between Tokyo and Osaka, the train system cost about $1 billion. Riding on the world's fastest train is said to be the closest thing to jet travel on the ground.

In the states the Golden Gate System is a striking new development in prospect for rapid transit systems. The San Francisco Bay Area Rapid Transit District is conducting test runs of a 4 mile portion of what will be a $1 billion transportation system between San Francisco and Oakland. New equipment such as radar systems for safety, a computer system for scheduling, and automatic controls for speed regulation are being tested.

Many new prospects for intercity railroad transportation are being suggested such as jet propelled trains, developed by United Aircraft Corporation. The experimental train, whose design is based on the technology of flight would go 160 miles per hour on existing trackage. Propelled by gas turbine engines, the train would have a power unit at each end, one pushing and one pulling. The approximate running time between New York and Washington would be 1 hour.

The R Rollway, an unconventional rail system, would be a toll road on wheels, carrying both motorists and their cars. The system, designed by a young Rumanian born inventor, Devdot Clejan, consists of oversize coaches which would carry 12 automobiles. Speeds of 200 miles per hour on track 18 feet wide are theorized.

Ford Motor Company has proposed a system called Levatrain, which is designed to glide on a thin film of air over a special roadway at speeds up to 500 miles per hour. The basic concept is simple; replacing wheels would be devices called levapads, metal plates shaped to fit over the top and down the sides of the rails like small, metal saddles. Compressed air pumped through a hole in the plate would lift it just a fraction of an inch off the rail, and at the same time, air would be pumped in each side to prevent lateral motion. Power supplied by a gas turbine engine would operate the propellers which would drive the vehicle along the track. The vehicle would be very safe; since the levapads fit around the rails like clamps, there would be no possibility of the train jumping off the tracks.

The most futuristic system being considered is called tube travel; through huge transparent pipelines criss-crossing the country, torpedo trains could hurtle at 1,000 miles per hour. Lawrence K. Edwards worked on a limited-vacuum concept and has set up the Tube Transit Incorporated for development of the idea. Trains would be driven forward by the pressure of air behind them; with extra acceleration given by gravity if the track sloped, riding time between Boston and Washington would be only 90 minutes. Dr. Joseph V. Foa, head of the department of aeronautical engineering and astronautics at Rensselaer Polytechnic Institute has proposed a vehicle which would need no vacuum at all. The train would propel itself by transferring the air ahead of it to the rear through passages within the vehicle and through the space separating it from the wall. A fan engine would suck in the air at front and blast it out behind; at the same time the fan would also be forcing some of the air through the pad projections keeping the vehicle nine inches away from the tube. Both systems are being considered a part of a vast system of tube transportation for the future.

It is estimated that $120 million is needed to finance research and development sufficient to envision the proposed systems in terms of operating and maintenance costs. Where will the money come from? One possibility would be government ownership. Another would be a public authority similar to Comsat, the company formed by industry and public investment to develop and operate a commercial satellite communication system. It is certain that something must be done to alleviate current transportation problems. Ideas have been supplied; all that is needed is public insistence that these ideas be developed.

The Bell SK-5 is a versatile, air-cushion vehicle capable of performing a variety of missions over land, water, ice, snow and marsh. It is the world's first ACV to be put into quantity production. The SK-5 carries up to 15 seated passengers or three tons of cargo.

Unique design of this seven-ton vehicle is a direct result of the highly successful development of long flexible trunks or skirts (see Figure 7). Without these skirts, an ACV of this size could not have a practical cross country and rough-water performance. A horizontally mounted fan forces air downward and beneath the craft. Forward propulsion is achieved by a conventional, variable pitch airplane propeller. Both the fan and the propeller are powered by a 1,000 hp turbine engine mounted atop the SK-5. The air actuated, flexible skirts enable the vehicle to travel on an air cushion more than four feet thick, providing a smoother ride, greater obstacle clearance and higher speeds.

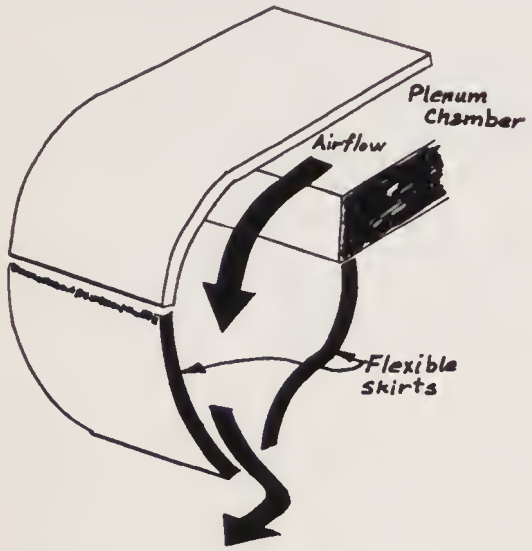

Figure 7

The integrated lift-propulsion system gives maximum power flexibility. Over smooth surfaces, additional power can be fed to the propulsion propeller at the expense of operating height, with a corresponding increase in speed (up to 70 mph). Conversely, over rough surfaces, speed can be reduced and operating height increased.

One of the fundamental considerations that immediately arises is that of control. If these vehicles are to move at high speeds close to the ground, a safe and powerful control system which can demonstrate characteristics along the lines we presently consider necessary for automobiles and trucks will be necessary. For example, consider for a moment the ability of our present day automobile to come to a stop. Figure 8 illustrates the stopping distance as a function of forward velocity typical of our modern automobile.

On first glance it would appear that this ground effect vehicle sliding along the surface of the ground on its cushion of air will never be able to approach this degree of effectiveness; however, let us again consider a vehicle such as the Bell SK-5. A horizontal propeller is used to provide the thrust necessary to maintain the vehicle in forward motion; this device can be used to provide a brake by simply reversing the propeller pitch. This technique is employed in modern propeller-driven aircraft. Figure 8 also illustrates the resulting braking distance if this technique is employed.

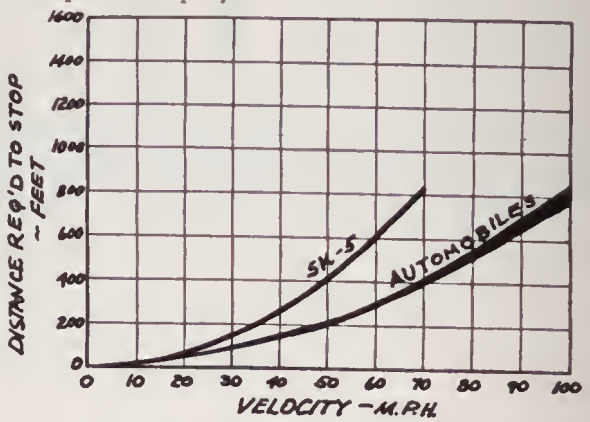

Figure 8. Stopping Distance

Although this does not provide a braking capability nearly as good as the automobile, nevertheless it does represent a considerable braking action.

Potential of ACV

Before concluding, we should consider the potential of these vehicles in the role of an over-water device. As illustrated in Figure 6, the ship represents a very efficient means of transportation in the water at low speeds. The power requirements for speeds over approximately 30 to 40 mph get completely out of hand.

Since the ground effect vehicle can operate with the same facility over the water as it can over land, it again may also play a role. In fact, it can be argued that it is in this over-water application that the air-cushion vehicle offers its greatest potential. There is no question that for the large machines which are inherently efficient, the ocean does not present the restrictions as to size as does the land. On reflection, the idea of extremely large vehicles designed to carry a large number of passengers or a great tonnage of cargo across the ocean at relatively high speeds, is not as far fetched as it appears at first thought. Suffice it to say, as long as speed is a consideration (and it always has been in the past), the ground effect vehicle may very well carve out a significant niche in the over-water transportation field.

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3. Ross, H. R. "New Transportation Technology," Science and Technology, No. 59, November 1966

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ENGINEERS' QUEEN 1967

LINDA LARSEN

TECH NEWS

by Doug Taylor

BOEING SUPER SONIC TRANSPORT

William M. Allen, Boeing President, announced that the aircraft company plans to build prototypes of its variable-swept wing transport at its development center in Seattle, pending Administration and Congressional approval for moving into the prototype phase of Boeing's development plan for the SST.

Sixty percent of the work on the SST will be subcontracted by Boeing. Foremost among the contractors is General Electric which will provide the engines for the Super Sonic Aircraft. The G.E. portion of the program is estimated at about 20% of the total SST program value.

Maynard L. Pennell, vice president and SST program director for Boeing, and other Boeing executives stressed their confidence in the variable swept-wing design, saying that the firm's continuing research has made it more evident than ever that the American SST should feature swept wings for efficient low- and high-speed performance. For this reason the Boeing SST will be highly competitive economically with the firm's subsonic model 707 - 320B Intercontinental.

The Boeing design features a variable sweep integrated wing which combines with a large horizontal tail to form a single delta-shaped lifting surface for supersonic flight. Aerodynamically, the wing will permit the SST to be three airplanes in one -- a supersonic machine capable of cruising at about 1,800 miles per hour; a subsonic airliner with good Mach 0.85 flight characteristics, and a slow-speed aircraft that exceeds the take-off and landing performance of today's big jet transport.

The Boeing plane has a cabin capacity of seven abreast, double aisle seating in one proposed cabin section. Fully loaded the plane will take off at 186 miles an hour in 7,600 feet of runway under Federal air regulation requirements, about the same speed and in less runway than a fully loaded 707 requires. Its landing approach speed will also be about the same as the 707 Intercontinental -- 154 miles an hour with a 6,400 ft. landing field requirement, according to the firm.

Slotted trailing edge flaps and leading edge slats along 85% of the plane's 180 ft. extended wing will produce added lift for take-off and landing. The airplane's four G.E. engines mounted under the large horizontal tail will be fitted with variable-geometry inlets that can "choke out" the high pitched sound from the engine compressors during airport approaches. The SST's wings will be swept at an angle of 42% for subsonic flight and 72% for supersonic flight.

The General Electric GE4 SST engine is an augmented turbojet 6 ft. in diameter and 25 ft. long. The compressor has nine stages with variable stators and the turbine is a two stage, air-cooled type. Turbine inlet temperature is above 2000°F.

The thrust class is 60,000 lbs. and the exhaust system uses noise suppression features and is integrated with the thrust reverser.

Model of Boeing's winning SST entry in NASA wind tunnel.

MAGNETIC PROXIMITY SWITCH

Electro-Tec Corp. has developed an inexpensive ac-dc magnetic proximity switch for highly reliable checking, counting and positioning of moving devices. When operated within specified tolerances, the electrical life of this permanent-magnet device is in the hundreds of million of operations.

The Model 01041 is easily installed in any position behind any non-ferrous shield and accurately detects presence of a specific magnetic body at a predetermined distance from a reference point. The switch is 1-15/32 in. x 1/2 in. x 5/16 in. Repeatability is ± 0.002 in. throughout life. Unaffected by shock and vibrations up to 50 g's, the encapsulated switch will operate when immersed in any fluid or under pressure and is unaffected by dirt, grease, oil, paint sprays, or other contaminates.

It is available off-the-shelf in both the normally-open and normally-closed positions.

CONTOUR PLOTTER

The Needham department of Northrop Corp.'s Nortronics Div. is marketing a device which produces permanent three-dimensional plots of the time-frequency-amplitude relationship of signals.

The ST-701 spectral contour plotter plots amplitude in closed contour lines in addition to the varying shades of gray. Either logarithmic or linear spacing of contour lines is possible.

Time and frequency are recorded as X and Y coordinates respectively. Resolution of the display is twice that of a standard television picture.

The plots have been used to investigate the diagnoses of various heart ailments. Plots show differences between various types of abnormalities.

SOLDER SYSTEM

A reflow soldering system, capable of making reflow solder bonds on ultra-miniature assemblies in less than 200 milliseconds, has been developed by Hughes Aircraft Co.

The system has a peg-like tip of .035-in.-dia., which is normally cool and is placed on the work before the solder cycle is initiated. A heat pulse of controllable duration is then applied and the tip holds the work in place.

SILICONE CARBIDE DIODE

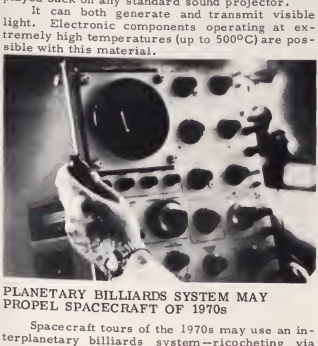
Norton Co. has developed a reproducible silicon-carbide electroluminescent diode. The device has applications in sound home movies, recording data on film, computer components, and in high-temperature electronic components.

Frequency response of the system is about 6,000 cycles per second.

The diode emits a needle-thin beam of cold yellow light at about 10^{-5} or one photon of light emitted for every 100,000 electrons passing through the diode. The diode is .030 x .030 x .015 in., and can operate on small batteries.

The diode requires no lenses or optics and needs a small solid state amplifier plus a microphone to record sound on film. The sound system can be used with black-and-white or color film purchased and processed by drug stores and played back on any standard sound projector.

It can both generate and transmit visible light. Electronic components operating at extremely high temperatures (up to 500°C) are possible with this material.



PLANETARY BILLIARDS SYSTEM MAY PROPEL SPACECRAFT OF 1970s

Spacecraft tours of the 1970s may use an interplanetary billiards system--ricocheting via gravitational drag from one planet to another. The unmanned spacecraft would be redirected at each planetary approach. The gravitational forces would enable the craft to pick up added energy as it changed course.

The new possibilities for solar system exploration are outlined in the December issue of the Astronautics and Aeronautics Journal by Dr. H. J. Stewart of the California Institute of Technology's Jet Propulsion Laboratory. According to Dr. Stewart, two propulsion developments now emerging from engineering research may open Jupiter and the outer planets, Mercury, regions outside the solar system, and even the sun to close-up inspection during the next decade. These developments are the use of planetary gravitational drag and solar-electric propulsion. Under study are systems using small ion engines and large solar panels for sustained low-thrust power.

Astronomers have long recognized the three-body effect--that a moving planetary gravitational field can change the heliocentric trajectory of another body. Mariner IV proved the theory in its flight by Mars in July 1965. Larger effects could be achieved in fly-bys of other planets with greater masses or, as in the case of Venus, higher orbital speed. Jupiter, with a mass 317 times that of the earth, has such a strong gravitational field that large deflections and changes in speed are possible.

Computations show that the spacecraft, launchable with present-day boosters, would have greatest chance for a successful grand tour to Neptune and beyond if launched in October 1978. It is estimated that such a tour, bouncing from Jupiter to Saturn to Uranus to Neptune, would require 8.9 years. Without the billiard-type acceleration, a direct flight from the earth to Neptune could take up to 30.7 years, depending on the launching vehicle used.

ORGANIC DYE LASERS FEATURE HIGH OUTPUT POWER

A new family of lasers has been reported that has both the extremely high output power of a giant-pulse ruby laser and the very small beam divergence of a gas laser.

The laser system, which is the subject of experiments at the International Business Machines Corporation, uses an organic photosensitizing dye in solution as the active medium. The dye is pumped by a giant-pulse ruby laser. Because the dye solution is of much higher optical quality than the crystal in a ruby laser, the output of the dye laser has the extremely high spatial coherence previously available only in gas lasers.

The small beam divergence of the new laser is of potential interest for a variety of giant-pulse laser applications, such as long-range laser radars and range finders.

The first dye tried in the experiment was 3,3'-diethylthiatricarbocyanine iodide (DTTC), which lases at a wavelength of 8160 Å in ethyl alcohol solution. There are hundreds of other photosensitizing dyes of very similar molecular structure, many of which can be expected to function as lasers. This family of dyes should make available giant-pulse laser beams of any wavelength between about 7000 and 15000 Å.

The efficiency of the DTTC laser is high: its output was about 14 percent of the pumping power in early experiments, and later was measured as high as 50 percent. The dye solution has shown no evidence of saturation at pumping levels of several hundred megawatts.

The work was partially supported by the Army Research Office, Durham, N. C.

Photo: Montecatini Co.

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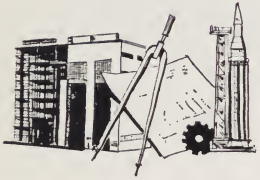

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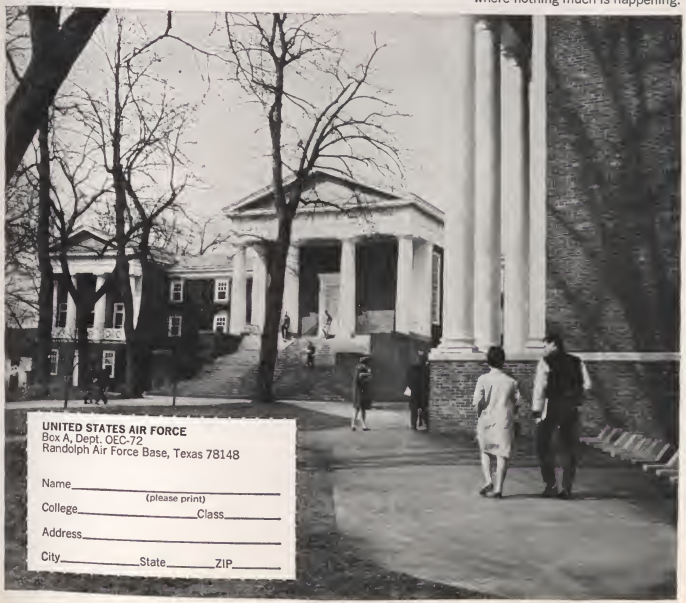

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